

Attachment 5: Workplan

Napa County Groundwater/Surface Water Monitoring Facilities to Track Resource Interrelationships and Sustainability

Component 1: Detailed Site-Specific Evaluation

Scope, maps and area: See Project Description (Att#4_LGA12_NapaCnty_ProjD_1of3) and related documents.

Purpose, Goals, and Objectives: The purpose of detailed site-specific evaluations are to characterize, in greater detail, the local and historic hydrogeologic conditions in the vicinity of potential monitoring sites and identify suitable locations for installation of groundwater and surface water monitoring facilities. Site-specific factors that will be considered in the final placement of monitoring wells and surface water monitoring installations for the project include the proximity to pumping wells and wells that are part of an existing or past monitoring program, estimated depth and thickness of alluvial aquifer materials, local groundwater elevations, and surface water features in the vicinity of the proposed monitoring sites. A good understanding of these elements will be important in determining the most beneficial monitoring site placements and determining preliminary well designs.

Task 1 Work Items

Task 1.1 – Data Gathering

Work Item 1.1.a. Incorporate available well driller's reports and geophysical logs: This task involves incorporation of additional hydrogeologic data from wells constructed in the vicinity of the proposed groundwater and surface water monitoring sites. Key data that will be assembled as part of this task include water well driller's reports and downhole geophysical logs. As part of Napa County's Updated Conceptualization and Characterization of Hydrogeologic Conditions in Napa County project (LSCE, 2012), an extensive database of well driller's reports was assembled and hydrogeologic data, including cross-sections, depth to bedrock contours, and isopach maps, were developed for the Napa Valley to show the general hydrostratigraphy of the area. In addition to these existing products, available well driller's reports and geophysical logs in the vicinity of proposed monitoring sites will be used to characterize the site-specific hydrogeology in greater detail.

Work Item 1.1.b. Evaluate long-term data on conditions in the alluvial aquifer system: Existing historic groundwater level and quality data have previously been assembled and included in the Napa County Data Management System (DMS) (LSCE, 2010b). Previously assembled data from the DMS, an existing County-managed relational water resources database, will be used together with updated information for the alluvial aquifer system in the vicinity of the proposed monitoring sites. Updated site-specific data may include data from Napa County, DWR, City of

Napa, City of St. Helena, and other entities (municipal and private) that own or monitor wells completed in the Napa Valley alluvial aquifer system.

Work Item 1.1.c. Collect long-term data on surface water quality and streamflow: Existing historic surface water quality and streamflow data will be assembled for gauges or other locations in the vicinity of the proposed monitoring sites. This includes data from the U.S. Geological Survey, DWR, and Napa County and other entities (municipal and private) that conduct surface water quality monitoring or streamflow gauging.

Work Item 1.1.d. Prepare maps: Digital GIS data and map products will be prepared to show the location of existing geologic cross-sections, locations of all wells and borings used in interpreting the detailed site-specific hydrogeology, and locations of wells with water level or water quality data used in the evaluation.

Task 1.2- Physical Hydrogeologic Interpretation and Illustration

Work Item 1.2.a. Conduct site-specific interpretation of hydrostratigraphic configuration: This task involves characterizing the hydrostratigraphy, including depth and thickness of alluvial aquifer materials, in the vicinity of each proposed monitoring site. Work on this task will utilize existing hydrogeologic data from existing countywide studies (Kunkel and Upson, 1960; LSCE, 2012). As appropriate, this task may include preparation of site-specific geologic cross-sections and contour maps of interpreted alluvial aquifer thickness to aid in the interpretation and characterization of the hydrostratigraphy at each proposed monitoring site.

Work Item 1.2.b. Prepare historic groundwater elevation hydrographs and contour maps: Select hydrographs and contour maps will be prepared based on data available for alluvial wells in the vicinity of each proposed monitoring site. Data from the County DMS and any additional available data for alluvial wells in the vicinity of proposed monitoring sites will be used to evaluate past site-specific groundwater level conditions and trends and design specific monitoring site configurations.

Work Item 1.2.c. Summarize existing water quality data: This task involves preparation of one or more tables or maps to summarize available existing groundwater quality data in the alluvial aquifer in the vicinity of each proposed monitoring site. Data from the County DMS and any additional available data for alluvial wells in the vicinity of proposed monitoring sites will be used to interpret past site-specific groundwater quality conditions and trends.

Component 2: Monitoring Well Installation

Scope, maps and area: See Project Description (Att#4_LGA12_NapaCnty_ProjD_1of3) and related documents.

Purpose, Goals, and Objectives: The purpose of this project component is to install wells to document and monitor groundwater conditions in the alluvial aquifer adjacent to a surface waterway. The objectives of this task are to establish dedicated groundwater monitoring points, with well-documented lithologic and construction details, that can be monitored to develop an understanding of how alluvial groundwater conditions change through time and in relation to

surface water conditions. Monitoring wells installed for this project would also address high priority groundwater data gaps near surface waterways in the Napa Valley Subbasin as identified recently by Napa County (LSCE, 2011a).

Task 2 Work Items

Task 2.1 – Monitoring Well Design

Up to six monitoring wells will be constructed, each containing up to two nested piezometers (i.e., two casings with screens located at different depth intervals, constructed in one borehole (Figure 5-1). Monitoring wells will be constructed such that piezometer screens intersect the targeted zones of the alluvial aquifer near the water table over the range of expected annual variation as determined for each site for Component 1. Preliminary well designs will also be based on site-specific hydrogeologic interpretation developed as part of Component 1 of the project. However, the final monitoring well design (e.g., total well depth, depth and length of the piezometer screens, depth of seals) will be determined based on field observations made during drilling (e.g., depth to first encountered groundwater and type of subsurface materials). This design provides a dedicated groundwater monitoring facility with the following qualities:

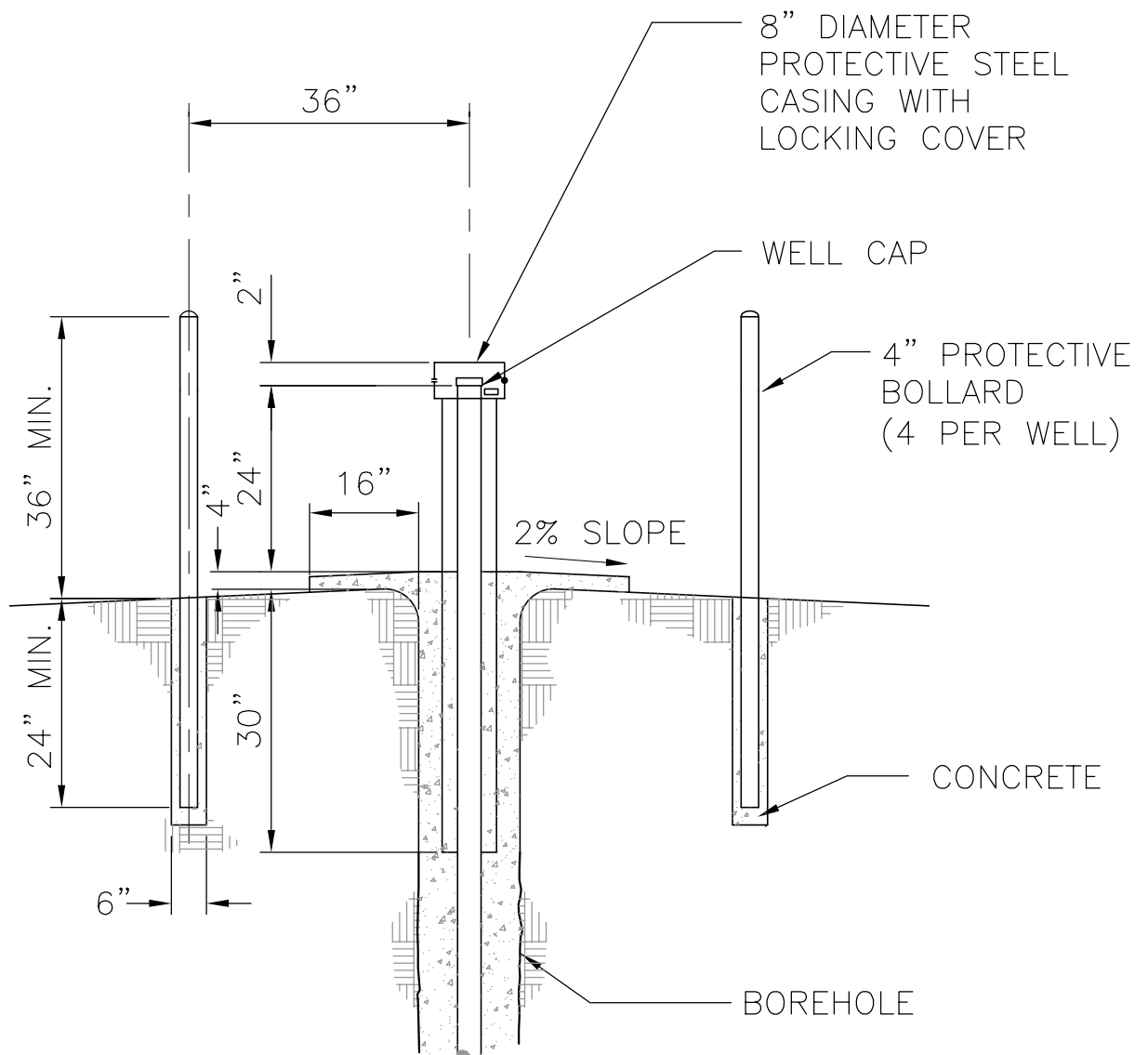
- ❑ Known and well-documented lithology;
- ❑ Documented construction details with targeted groundwater monitoring zones;
- ❑ Advantageous depth-specific placement with regard to hydrogeologic conditions and relative to surface waterways;
- ❑ Reduced vulnerability to seasonal and longer-term water level fluctuations compared to single-completion monitoring wells;
- ❑ Greater suitability for the installation of shorter screen lengths (e.g., 5-15 feet), which helps reduce effects of vertical flow components in the wells; and
- ❑ Usefulness for depth-profiling of groundwater level, temperature, and other water quality characteristics.

A schematic for the design of a typical nested monitoring well is shown in Figure 5-1. Figures 5-1 and 5-2 show alternatives for monitoring well surface completion including surface completion with casing stick-up and bollards and a traffic valve box for below-grade completion (Note: Figure 5-2 does not depict a nested monitoring well construction although such a construction is possible with the surface completion shown.) The actual configuration of the surface completion will be determined prior to drilling based on local conditions near the well location and communication/consensus with the appropriate land owner and/or manager.

All wells constructed for the project will be sited on public property. Napa County Flood Control and Water Conservation District (Flood District) staff, two geohydrologists from Luhdorff & Scalmanini, Consulting Engineers, and a representative from Napa County Resource Conservation District conducted preliminary site visits in June 2012 in order to determine basic drilling site suitability, including drill rig accessibility, in preparation for seeking drilling cost estimates.



**Figure 5-1
Typical Nested Groundwater
Monitoring Well Profile**



NOTE:

DIMENSIONS OF CONCRETE
PAD SUBJECT TO
LOCAL REQUIREMENTS.

Task 2.2 – Monitoring Well Construction and Development

Prior to monitoring well construction, appropriate well construction permits will be obtained through the Napa County Department of Planning, Building, and Environmental Services. Well construction will be performed by a qualified California licensed professional well drilling contractor (C-57 license), selected through a competitive screening process. The drilling contractor will be responsible for adherence to trade-specific health and safety measures during drilling, installation, and site cleanup.

Because of the planned shallow completion of the monitoring wells and expected unconsolidated nature of subsurface materials in the project area, it is anticipated that the hollow-stem auger method will be employed for the advancement of boreholes. Drilling and construction oversight will be provided by a licensed California professional geologist or professional civil engineer with experience in the water well construction business or under the direct supervision of such a professional. Subsurface materials will be sampled continuously using a split spoon sampler or other similar coring method. Borehole lithology will be described and logged in the field by a California professional geologist or under his/her direct supervision. The description of the borehole samples will follow the American Society for Testing and Materials (ASTM) Unified Soil Classification System (USCS). Material samples will be archived for a minimum of one year from the date of retrieval.

Up to six monitoring wells containing up to two nested piezometers will be constructed in accordance with the final design details provided by the supervising geologist or engineer depending on the subsurface conditions encountered during the borehole drilling. A preliminary typical nested monitoring well design consisting of two 2-inch diameter PVC casings nested inside a 10-inch borehole is illustrated in Figure 5-2. Gravel pack will be placed in the annular space around screened sections and a bentonite seal will be installed to isolate the two screened zones of each well. A shallow concrete surface seal and deeper cement grout annular seal will also be installed. Actual borehole depth, casing depth and screened intervals, and seal locations will be finalized at the time of well drilling and construction. For the purpose of estimating project costs, preliminary monitoring well designs assume nested piezometer depths of 50 feet and 100 feet in each monitoring well.

All monitoring wells will be developed as the drilling program progresses and each monitoring well will be developed within two weeks of its installation. The purpose of well development is to develop the gravel pack and aquifer to ensure that proper groundwater samples can be obtained from the monitoring facility. Since the proposed drilling methods do not utilize drilling fluids, the overall monitoring well development efforts are expected to be relatively straightforward.

Monitoring wells will initially be bailed to remove any solids that may have accumulated in the piezometer casing during installation. The gravel envelope will be cleaned by surging and pumping opposite each screen interval until the gravel has been cleaned and consolidated. The surging and pumping operations will be conducted until each screen section is fully developed and the piezometer discharges clean groundwater.

Task 2.3 – Groundwater Level and Quality Monitoring Instrumentation

The groundwater level and water quality monitoring instrumentation project task includes installation and initial calibration of automated and continuous groundwater level, temperature, and electrical conductivity monitoring equipment in up to 12 new piezometers constructed in project Task 2.2. This task includes acquisition, initial calibration, installation, and programming of automated monitoring equipment in each of the 12 piezometers. Monitoring instruments will be vented to adjust for atmospheric conditions and will be capable of continuously measuring water conditions satisfying the following criteria:

- ❑ water level with an accuracy of at least +/- 0.5% of the water level range
- ❑ temperature with an accuracy of at least +/- 0.5 degree Celsius (°C)
- ❑ electrical conductivity with an accuracy of at least +/- 0.5%.

The specific details of instrumentation will be finalized after initial measurements of water levels and water quality parameters are conducted. This will ensure that all instruments are capable of monitoring the full range of groundwater conditions (at appropriate resolutions) while placed at target depths within the piezometer. Preliminary cost estimates for instrumentation provided in this application are based on a versatile multi-parameter sensor and data logger produced by Instrumentation Northwest Inc., model: AQUISTAR® CT2X Smart Sensor with optional pressure sensor and vented cable, or comparable.

Component 3: Surface Water Monitoring Station Installation

Scope, maps and area: See Project Description (Att#4_LGA12_NapaCnty_ProjD_1of3) and related documents.

Purpose, Goals, and Objectives: The purpose of this project component is to establish, upgrade, or augment dedicated surface water monitoring stations to collect data on surface water levels, temperature, and electrical conductivity to complement the existing network of stream gaging sites managed by the USGS and Napa County Flood Control and Water Conservation District (Flood District). The objective of this task is to provide facilities with which to monitor changes in surface water conditions in order to evaluate the relationship between groundwater and nearby surface water resources. As necessary and appropriate, existing surface water monitoring sites will be upgraded to collect data at frequencies and resolutions needed to meet overall project objectives.

Task 3 Work Items

Task 3.1 - Install Surface Water Level and Quality Monitoring Instrumentation

The purpose of installing surface water monitoring facilities and instrumentation is to provide continuously-measured water level, temperature, and electrical conductivity data consistent with adjacent groundwater monitoring activities described in Component 2 in order to better understand the relationship between groundwater and nearby surface water resources. Where existing USGS or Flood District surface water monitoring facilities already exist, stations will be

augmented to collect surface water stage and basic water quality data suitable for use in these groundwater/surface water relationship analyses.

USGS streamflow gauges exist at two of the proposed monitoring sites and have full historic records of streamflow and stage height with some historic periods of temperature data. The intent of this project task is to augment these sites, in cooperation with the USGS, to continuously monitor surface water temperature and electrical conductivity in addition to stage height. The Flood District also maintains surface water monitoring stations at three of the other proposed monitoring sites and has historic flow and stage data at these locations; however, the instrumentation at several of these sites is not suitable for monitoring of low-flow conditions or basic water quality parameters, conditions which are of particular interest in this project. This project will install surface water monitoring instruments at these three Flood District sites to continuously record surface water stage, temperature, and electrical conductivity under all flow conditions through the duration of this project. One new surface water monitoring site will also be installed in order to provide stage and basic water quality data in a previously unmonitored reach of the Napa River for at least the duration of this project.

Personnel from the Flood District, Richard Thomasser, and USGS, Michael Webster, with oversight authority for the existing surface water gauges have been consulted during the development of this Work Plan. Project staff will continue to consult with Mr. Thomasser and Mr. Webster as the proposed instrumentation is installed and maintained alongside existing instrumentation. With sufficient interest on the part of Mr. Thomasser or Mr. Webster, more permanent and long-term facilities and equipment could be installed at these sites pending the availability of additional funding beyond what is proposed here. However, the surface water instrumentation proposed herein will be sufficient for the scope and intent of the current project.

Surface water monitoring facilities and instrumentation will be installed in a manner to provide reliable data on surface water stage, temperature, and electrical conductivity under the widest range of flow conditions possible. Site specific conditions will be considered when installing each instrument in order to obtain representative data. Surface water monitoring facilities will include structural components necessary to enable the installation and protection of surface water monitoring instrumentation. At a minimum, these facilities will consist of protective piping and conduit secured to existing stream gauging infrastructure or bridges to house the surface water monitoring instrumentation.

The surface water level and quality monitoring instrumentation project task includes installation and initial calibration of automated and continuous water level, temperature, and electrical conductivity monitoring equipment at six surface water monitoring stations throughout Napa Valley and collocated with project monitoring wells (Task 2). This task includes purchase, initial calibration, installation, and programming of automated monitoring equipment at each of the six surface water monitoring sites. Monitoring instruments will be vented to adjust for atmospheric conditions and will be capable of continuously measuring water conditions satisfying the following criteria:

- ❑ water level with an accuracy of at least $\pm 0.5\%$ of the water level range
- ❑ temperature with an accuracy of at least ± 0.5 degree Celsius ($^{\circ}\text{C}$)
- ❑ electrical conductivity with an accuracy of at least $\pm 0.5\%$.

Preliminary cost estimates for instrumentation provided in this application are based on a versatile multi-parameter sensor and data logger produced by Instrumentation Northwest Inc., model: Aquistar® CT2X Smart Sensor with optional pressure sensor and vented cable, or comparable.

Task 3.2 – Surveying Groundwater and Surface Water Monitoring Sites

Establishment of accurate and precise horizontal and vertical datums at groundwater and surface water monitoring sites are critical in order to quantify the relationship between groundwater and surface water resources as part of this project. A California licensed professional (licensed land surveyor or civil engineer with land surveying experience) will survey all monitoring sites. To ensure adequate measurement accuracy and precision, the horizontal and vertical position of the top of the well casings of the new monitoring wells will be determined in accordance with the National Oceanic and Atmospheric Administration's (NOAA) *National Geodetic Survey User Guidelines for Single Base Real Time GNSS Positioning* (Henning, 2010) using a professional-grade global navigation satellite system. Wellhead elevation and surface water monitoring datums will be determined with a vertical accuracy of 0.01 foot and their horizontal position will be determined with an accuracy of 0.02 foot.

Component 4: Ongoing Water Level and Quality Data Acquisition and Management

Scope, maps and area: See Project Description (Att#4_LGA12_NapaCnty_ProjD_1of3) and related documents.

Purpose, Goals, and Objectives: The purpose of this project component is to assemble all groundwater and surface water monitoring data and ensure that data are accurate and reliable. The objective of this task is to establish and follow procedures for downloading acquired monitoring data, performing manual field measurements, maintaining monitoring instrumentation, and managing collected data in order to achieve the most accurate and complete datasets possible. This task will include verifying the correct operation of monitoring instruments and managing all data derived during the course of the project

Task 4 Work Items

Task 4.1 –Water Level and Quality Data Acquisition and Instrument Maintenance

Work Item 4.2.a. Water quality sampling: After completion of all well development activities and surface water monitoring station installation, initial baseline water quality samples will be collected from all piezometers and at surface water monitoring sites in accordance with USGS field water quality sampling guidelines (U.S. Geological Survey, 2012). Field water quality parameters including temperature, electrical conductivity, and pH will be measured at the time of sample collection. Water samples will be sent to an appropriately certified laboratory for analytical water quality testing.

One round of field water quality sampling will be conducted to establish initial baseline water quality as part of this project and to evaluate groundwater and surface water quality and the interrelationship of these resources. Water quality sampling at these monitoring sites will also be incorporated in the County's overall countywide groundwater monitoring program and will complement the development of the County's Comprehensive Groundwater Monitoring Program initiated in 2009. Future water quality sampling at monitoring sites established as part of this project would be conducted by the County to fulfill objectives of their planned Comprehensive Groundwater Monitoring Program.

Work Item 4.2.b. Water level and quality instrument download and maintenance: After initial water quality sampling has been performed and automated water level and water quality logging instruments are programmed, installed, and data collection is initiated, periodic field visits to groundwater and surface water monitoring sites will be conducted to download data as needed, manually measure field water levels and water quality parameters including temperature and electrical conductivity, calibrate instruments, and verify correct instrument operation. At a minimum such visits will be conducted at the following times:

- 1) at installation of the groundwater and surface water monitoring instruments and initiation of automated data collection,
- 2) two weeks after initiation of automated data collection,
- 3) one month after initiation of automated data collection,
- 4) monthly for the first year of automated data collection,
- 5) quarterly thereafter, as the grant schedule and instrument calibration sensitivity allow.

During the initial site visits, facilities and instruments will be visually inspected, data collected by the monitoring instruments will be downloaded, and field water quality parameters will be measured manually. At this time, manually collected data will be compared with data collected by the automated monitoring equipment to verify instrument accuracy. If necessary, instruments will be cleaned and maintained, including battery replacement when needed, and data logging operations will be continued.

Task 4.2 – Management of Project Data

Groundwater and surface water monitoring data derived during this project will be assembled in a database or other data management structure for project-specific analyses. The project data management structure will be designed to enable the statistical and geospatial interpretations for evaluating the relationship between ground and surface water resources as part of this project. Furthermore, during the course of the project, data will be reviewed to identify notable trends and relationships in water levels and quality and detect any potential data accuracy or consistency problems.

Project data will ultimately be incorporated into the Napa County DMS, an existing County-managed relational water resources database, in order to facilitate reliable archiving and effective data extraction, display, and analysis. Additionally, data from this project will be provided to state and federal agencies, as appropriate, to facilitate broader public data dissemination and availability.

Component 5: Project Data Analysis and Reporting

Scope, maps and area: See Project Description (Att#4_LGA12_NapaCnty_ProjD_1of3) and related documents.

Purpose, Goals, and Objectives: The purpose of this project component is to conduct thorough analysis of the project data and report conclusions regarding the existing hydrogeologic conditions and trends and interrelationships between groundwater and surface water resources at the monitoring sites. Data will be displayed, analyzed, and evaluated to characterize the nature of the relationship between groundwater and surface water resources in the vicinity of each monitoring site. Reports will provide comparisons of groundwater and surface water levels and quality and will summarize the hydrogeologic conditions and relationships between groundwater and surface water resources at each site.

Task 5 Work Items

Task 5.1 – Quarterly Status Reports

Project status reports will be submitted on a quarterly basis to document progress with respect to the project schedule (see Attachment 7) and tasks detailed in this work plan.

Task 5.2 – Data Analysis

Analyses of project data will focus on evaluating groundwater and surface water interactions under various hydrologic conditions over the course of an annual cycle. Specifically, project analyses will address water level, temperature, or electrical conductivity gradient trends evident through comparisons of groundwater at two depths and nearby surface water. Additionally, analyses will provide comparisons of changes in groundwater and surface water levels and quality through a groundwater pumping season and under high- and low-water conditions. Techniques for interpreting and understanding project data may include general statistical comparisons, analysis of spatial statistical relationships, and analytical modeling.

Task 5.3 – Final Report

A final project report will be provided summarizing the results and interpretations of the study. The final project report will focus on evaluating the relationship between groundwater and surface water resources at each monitoring site. The report will provide discussion and rationale of project design and site selection and will also include as-built diagrams for all monitoring facilities installed as part of the project. The final report will compare groundwater and surface water levels and quality and will characterize hydrogeologic conditions and temporal and spatial trends in groundwater and surface water resources at each site. Draft versions of the final report will be reviewed internally by the County and will also be provided to DWR, USGS, NRCD, and possibly other interested parties for review and feedback.

Task 5.4 – Stakeholder and Community Outreach

The conduct of this project, project status, and results will be periodically communicated through Napa County's established GRAC and associated public outreach methods such as public newsletters.

Stakeholder outreach will be conducted through the Napa County Groundwater Resources Advisory Committee (GRAC). The GRAC is currently developing a Communication and Education Plan (see Att#5_LGA12_NapaCnty_WrkPln_2of2). The purpose of the plan is to serve as a strategic guide for the public communication and education activities of the GRAC, including groundwater monitoring. The goals of the plan are to ensure that Napa County residents are well-informed about the activities of the GRAC and to increase the understanding of groundwater resources so that Napa County residents as a whole have a factual basis for discussion and decision making.

Task 5.5 – Project Management

Napa County will provide overall project management and grant administration, including oversight of the technical work program and consultants, procurement of contractors for well drilling and development, procurement of instrumentation, review of status reports and the final project report and invoicing.

Project progress and performance will be continuously evaluated by the Project Manager and the LSCE project leader as described in Attachment 8. Performance and evaluation procedures will include the following:

- Coordination of project activities;
- Day-to-day direction of project staff;
- Formal and informal communications and reporting to DWR; and
- Assurance/oversight of overall quality and quantity of the information obtained.

In addition to project oversight and review provided by the County, LSCE will follow its own internal structure for project management, performance, and internal review. This includes oversight of project related tasks by a California Professional Engineer and/or Geologist as appropriate.

References

Kunkel, F. and J.E. Upson. 1960. Geology and groundwater in Napa and Sonoma Valleys Napa and Sonoma Counties California. U.S. Geological Survey Water Supply Paper 1495.

Henning, W. 2010. *National Geodetic Survey User Guidelines for Single Base Real Time GNSS Positioning* version 1.1. National Oceanic and Atmospheric Administration's (NOAA).

LSCE. 2010a. Task 1, Napa County Data Management System. TM.

LSCE. 2010b. Task 2, Review and Evaluation of Data Collection Procedures and Recommendations for Improvement. TM.

LSCE. 2010c. Task 3.2, Conceptual Model Review of Napa Valley Groundwater Model. TM.

LSCE. 2010d. Task 3.3, Guidance on Precipitation and Streamflow Monitoring Activities, Napa County, CA.TM.

LSCE. 2011a. Task 4, Napa County Groundwater Conditions and Groundwater Monitoring Recommendations. Report.

LSCE. 2011b. Task 5, Groundwater Planning Considerations and Review of Napa County Ordinance and Permit Process. Technical Memorandum.

LSCE. 2011c. Napa County, Statewide Groundwater Elevation Monitoring (CASGEM) Network Plan.

LSCE. 2012. Proposal for Napa County, Conceptualization/Characterization of Hydrogeologic Conditions.

U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, available online at <http://pubs.water.usgs.gov/twri9A>., accessed July 6, 2012.